The Labor Impact of Corporate Bankruptcy: Evidence from Worker-Firm Matched Data*

John R. Graham, Duke University and NBER

Hyunseob Kim, Cornell University

Si Li, Wilfrid Laurier University

Jiaping Qiu, McMaster University

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Abstract

This paper quantifies the "human costs of bankruptcy" by estimating employee wage losses induced by the bankruptcy filing of employers using worker-firm matched data from the U.S. Census Bureau's LEHD program. We find that employee wages begin to deteriorate one year prior to bankruptcy. One year after bankruptcy, the magnitude of the decline in annual wages is 30% of pre-bankruptcy wages. The decrease in wages persists (at least) for five years post-bankruptcy. The present value of wage losses summed up to five years after bankruptcy amounts to 1.4 times of pre-bankruptcy annual wages for the average employee. Furthermore, we find that the ex-ante wage premium to compensate for the ex-post wage loss due to bankruptcy can be of similar magnitude with that of the tax benefits of debt.

JEL Classification: G3, G32, G33, J24, J31, J33;
Keywords: Bankruptcy; Costs of financial distress; Human capital; Wage loss; Capital structure

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* John Graham (john.graham@duke.edu), Fuqua School of Business, Duke University, Durham NC 27708, phone: (919) 660-7857, fax: (919) 660-8038; Hyunseob Kim (hk722@cornell.edu), Samuel Curtis Johnson Graduate School of Management, Cornell University, Ithaca, NY 14583, phone: (607) 255-8335; Si Li (sli@wlu.ca), Financial Services Research Centre, School of Business and Economics, Wilfrid Laurier University, Waterloo, Ontario N2L 3C5, Canada, phone: (519) 884-0710 ext. 2395, fax: (519)888-1015; Jiaping Qiu (qiu@mcmaster.ca), DeGroote School of Business, McMaster University, Hamilton, Ontario L8S 4M4, Canada, phone: (905) 525-9140 ext. 23963, fax: (905) 521-8995. We thank Bert Grider at the Triangle Census Research Data Center for help with data and clearance requests. We also thank Ashwini Agrawal (AFA discussant), Todd Gormley, Andrew Karolyi, David Matsa, Roni Michaely, Karin Thorburn (Cavalcade discussant), Pab Jotikasthira (CICF discussant), Wei Wang (EFA discussant), and seminar and conference participants at AFA, Census Bureau RDC Conference in Chicago, Cornell University, CICF, EFA, IDC Summer Finance Conference, and SFS Finance Cavalcade for helpful feedback. Any opinions and conclusions expressed herein are those of the author and do not necessarily represent the views of the U.S. Census Bureau. All results have been reviewed to ensure that no confidential information is disclosed. This research uses data from the Census Bureau's Longitudinal Employer Household Dynamics Program, which was partially supported by the following National Science Foundation Grants SES-9978093, SES-0339191 and ITR-0427889; National Institute on Aging Grant AG018854; and grants from the Alfred P. Sloan Foundation. We are grateful to Lynn LoPucki of UCLA for sharing his Bankruptcy Research Database. Kim acknowledges generous financial support from the Kwanjeong Educational Foundation. Li and Qiu acknowledge financial support from the Social Sciences and Humanities Research Council of Canada. The initial version of this paper was titled "Human Capital Loss in Corporate Bankruptcy."

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Abstract

This paper quantifies the "human costs of bankruptcy" by estimating employee wage losses induced by the bankruptcy filing of employers using worker-firm matched data from the U.S. Census Bureau's LEHD program. We find that employee wages begin to deteriorate one year prior to bankruptcy. One year after bankruptcy, the magnitude of the decline in annual wages is 30% of pre-bankruptcy wages. The decrease in wages persists (at least) for five years post-bankruptcy. The present value of wage losses summed up to five years after bankruptcy amounts to 1.4 times of pre-bankruptcy annual wages for the average employee. Furthermore, we find that the ex-ante wage premium to compensate for the ex-post wage loss due to bankruptcy can be of similar magnitude with that of the tax benefits of debt.

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1. Introduction

Corporate financial distress and bankruptcy impose significant costs on firms and their stakeholders. In the corporate bankruptcy literature, quantifying bankruptcy costs is an important empirical question (e.g., Senbet and Wang, 2012). In particular, indirect costs, such as the loss of product market shares (Opler and Titman, 1994), inefficient asset sales (Shleifer and Vishny, 1992), and losses resulting from the firm's interaction with non-financial stakeholders including customers, suppliers, and employees (Titman, 1984) are argued to be critical.[1] These indirect costs, however, are difficult to quantify particularly for a broad sample of firms. A few papers provide empirical evidence on specific indirect costs of financial distress, including the loss of market shares to competitors (Opler and Titman, 1994) and asset fire sales (Pulvino, 1998, 1999; Ramey and Shapiro, 2001). There is, however, little research examining the labor consequences of corporate bankruptcy, even though employees are an important group of the firm's stakeholders and human capital plays a critical role in firms and in the overall economy.[2]

This study fills this void by quantifying the income consequences of corporate bankruptcy for employees.[3] Combining worker-firm matched data from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program with a comprehensive database of Chapter 11 bankruptcy cases, we estimate the wage loss for employees around the bankruptcy filing of their employers. The key feature of the LEHD data

[1] In contrast, the literature shows that direct costs of financial distress, such as litigation fees, are relatively small ranging from 1% to 6% of pre-bankruptcy firm value (Warner, 1977; Altman, 1984). In addition, Andrade and Kaplan (1998) use a sample of 31 highly levered transactions and show that the *total* costs of financial distress (which include both direct and indirect costs) range from 10% to 23% of pre-distress firm value.

[2] For example, wages account for roughly two-thirds of national output in the U.S. economy (Source: Bureau of Economic Analysis).

[3] The consequences of bankruptcy on workers also include pension losses, psychological and social costs, and others. These costs are typically unavailable due to data constraints (Davis and von Wachter, 2011). This paper thus focuses on the wage loss due to bankruptcy.

is that we can follow individual workers over time across employers observing their wages and other characteristics. Given that a significant fraction of workers leave the firm after a bankruptcy filing (Hotchkiss, 1995), observing wages of workers independent of post-bankruptcy employers is crucial for precisely estimating the wage impact of bankruptcy.

Using 138 bankruptcy filings by public firms from 1992 to 2008 and following 96,538 workers who were employed by bankrupt firms across the U.S., we find that employee wages begin to deteriorate one year prior to bankruptcy. By two years after bankruptcy, the decline in annual wages for the average worker is roughly 30% of pre-bankruptcy wages. The present value of wage losses from the year of bankruptcy to five years after bankruptcy amounts to about 1.4 times of pre-bankruptcy annual wages for the average employee. Furthermore, we find that almost half of the employees of the bankrupt firm leave the firm within five years after a bankruptcy filing.

Existing theories provide several explanations for the significant wage losses following bankruptcy. First, firm- or industry-specific human capital (Becker, 1962; Neal, 1995) or good matches between employees and employers (Jovanovic, 1979) may be lost for workers who separate from the previous firm or industry (Topel, 1991). Second, the previous employer may have paid a premium over the market prevailing wage (or marginal value of product) due to union bargaining power (Robinson, 1989), in order to induce unobservable efforts (Lazear, 1981), or to screen workers on their ability (Harris and Holmstrom, 1982). In these settings, if the workers' post-bankruptcy jobs pay market wages, they are likely to earn lower wages.[4]

[4] For employees who stay with the bankrupt firm post-bankruptcy, the mechanisms for wage losses may be different (e.g., bargaining down wages at distressed employers and low productivity). We separately examine wage changes for workers who keep being employed by the bankrupt firm and those who leave the firm in Section 3.3.

After documenting the significant impact of bankruptcy on worker earnings and employment, we examine the implications of the wage losses for corporate policies, specifically, corporate capital structure. Building upon previous theoretical research arguing that wage losses upon bankruptcy would indirectly affect capital structure decisions (Titman, 1984; Berk, Stanton, and Zechner, 2010), we first attempt to quantify the "indirect costs of financial distress" due to the expected earnings losses in financial distress.

In particular, we estimate these costs in terms of "compensating wage differentials" – additional compensation for the risk of experiencing wage loss in financial distress (Abowd and Ashenfelter, 1981; Topel 1984; Agrawal and Matsa, 2013). In a competitive labor market, employees of highly levered firms would be compensated more (relative to those of less levered firms) for the risk of wage loss due to a larger likelihood of financial distress (Berk et al., 2010), which in turn gives firms a disincentive to take on leverage. To the extent that workers anticipate potential wage losses due to financial distress and the expected earnings loss is ultimately borne by the firm, this approach is likely to provide reasonable estimates for the *ex-ante* indirect cost of distress related to wage losses.[5]

We find that for the average BBB-rated firm, the expected cost of additional compensation for bankruptcy-driven wage loss is about 6% of firm value, which can account for the difference between the tax benefits of debt and the "traditional" costs of financial distress for the firm estimated in previous research (e.g., Almeida and Philippon, 2007). Moreover, across firms with different levels of credit ratings and leverage, the magnitude of

[5] Agrawal and Matsa (2013) point out that workers can gauge their employment stability by observing direct signals of the firm's financial conditions such as financial leverage and credit ratings, but can rely on more indirect signals from coworkers, management, the media, and from other aspects of the economic conditions. In addition, Brown and Matsa (2012) find that job seekers accurately perceive firms' financial health, suggesting that firm employees likely perceive the effect of financial health on their job security as well (or even more accurately). See Abowd and Ashenfelter (1981), Hamermesh and Wolfe (1990), Li (1986), and Topel (1984) for general evidence on compensating wage differentials and Agrawal and Matsa (2013), Brown and Matsa (2012), and Chemmanur et al. (2012) for more recent evidence in the capital structure context in particular.

the ex-ante wage premium due to "human capital risk" is of similar magnitude with the differences between the tax shields and the expected "traditional" distress costs (Andrade and Kaplan, 1998; Graham, 2000). Therefore, our results suggest that taking human costs of bankruptcy into account can potentially resolve the "debt conservatism puzzle."[6]

Our findings have important implications for at least three strands of literature. First, our paper adds to the empirical literature on corporate bankruptcy in financial economics and law. Previous research has examined the effects of bankruptcy filings on firm-level outcomes such as accounting performance, asset size, and management turnover (Hotchkiss, 1995; LoPucki and Whitford, 1992; Gilson, 1989). Relatively less attention has been paid to the consequences of bankruptcy for employees, partly due to limitations in data on workers. To the best of our knowledge, our paper is the first to use worker-firm matched micro data and to quantify wage loss experienced by workers after bankruptcy filings of employers.[7] Moreover, given the active debate in law and finance as to the efficacy of Chapter 11 as a means to reorganize businesses and to protect employees, the results in our paper would improve our understanding of the beneficiaries of the Chapter 11 bankruptcy process.[8]

[6] We acknowledge that using compensating wage differentials may not be the only approach to translate the ex-post wage loss for employees into ex-ante cost of debt for the firm. For example, employees of a highly-leveraged firm might optimally choose to invest less in their firm-specific human capital, which reduces their productivity (Jaggia and Thakor, 1994). Highly levered firms may also lose high-quality employees or job candidates to competing firms with lower leverage due to low job stability (Brown and Matsa, 2012). The bottom line is that as long as employees anticipate the effects of the firm's financial health on the stability of their jobs, the firm would ultimately bear the costs associated with potential wage loss. Nonetheless, our approach based on compensating differentials provides a straight-forward, yet sensible way to quantify the indirect cost of distress to the firm.

[7] Eckbo and Thorburn (2003) and Eckbo, Thornburn, and Wang (2012) estimate earnings losses due to bankruptcy for Swedish and U.S. CEOs, respectively. Benmelech, Bergman, and Enriquez (2012) use firm and pension plan-level wage data to estimate the magnitude of downward wage renegotiation in financial distress of airline firms. However, none of these papers uses individual worker-level data to estimate worker wage losses across a broad sample of financially distressed firms.

[8] The 1978 Bankruptcy Reform Act, which formed the basis of the modern bankruptcy code, suggests that preserving jobs is an important goal of Chapter 11 (see Ondersma (2009) and references therein). For example, House of Representative Report, No. 95-595, p. 220 (1977) states "The purpose of a business reorganization case, unlike a liquidation case, is to … provide its employees with jobs … It is more economically efficient to reorganize than to liquidate, because it preserves jobs and assets."

Second, by estimating the labor-related indirect cost of financial distress, this paper contributes to the capital structure literature. We show that the expected costs of financial distress that incorporate the cost implied by employee wage losses could be large enough to offset the tax benefit of debt (Graham, 2000). Furthermore, our results provide an important underpinning for theories arguing that the risk of losing human capital due to bankruptcy is a key driver of corporate leverage choices. Models of Titman (1984), Jaggia and Thakor (1994), and Berk, Stanton, and Zechner (2010) show that this concern for labor should be a consideration for ex-ante employer capital structure choices, and Agrawal and Matsa (2013) and Kim (2013) show consistent evidence on corporate leverage choices. Our paper contributes to this literature by showing that employees suffer significant wage losses in financial distress, and bankruptcy in particular, which is a key presumption of the theoretical and empirical work.

Third, our paper contributes to the larger literature in labor economics that examines displaced employees' wage loss (e.g., Jacobson, LaLonde, and Sullivan, 1993; Couch and Placzek, 2010; Davis and von Wachter, 2011). The results in our paper advance the literature by showing that both workers who stay with and those who leave the firm post-bankruptcy experience substantial earnings losses, suggesting that financial distress of a firm has negative effects on its employees beyond job displacements.

The rest of the paper proceeds as follows. The next section describes the data, variables, and summary statistics. Results, implications, and robustness tests are given in Section 3. Section 4 further discusses our results. The last section concludes.

2. Data and Summary Statistics

2.1 Sample Selection

We begin by identifying corporate bankruptcy cases based on the UCLA-LoPucki Bankruptcy Research Database (BRD).[9] This database has been used in the literature to study corporate bankruptcy (e.g., Eckbo, et al., 2012; Goyal and Wang, 2012; Jiang et al., 2012; Wang, 2009). The BRD contains public companies with more than $100 million of assets (measured in 1980 dollars) that filed cases under Chapter 11 of the U.S. Bankruptcy Code from October 1, 1979 to present.[10] We exclude financial and utilities firms based on their SIC codes.

For these Chapter 11 filers, we obtain worker-level information such as age, education, gender, and wages from the U.S. Census Bureau's Longitudinal Employer-Household Dynamics (LEHD) program, and firm-level information from the Compustat and CRSP databases. The LEHD program covers thirty participating U.S. states as of 2012 and provides detailed information on individual workers' wage and other characteristics.[11] We link datasets from the LEHD data with other Census Bureau business data, and subsequently with Compustat and CRSP using the Business Register Bridge (BRB). Specifically, among the databases available from the LEHD data, we use the Individual Characteristics File (ICF) which provides worker-level characteristic variables such as gender and birth year, the Employment History File (EHF) which contains annual and quarterly earnings for each worker-firm pair, and the Unit-to-Worker Imputation File (U2W) which is used for job-location imputation at the SIC (or NAICS) industry and county level. Then we use the Compustat-SSEL Bridge (CSB) in conjunction with the SSEL-Name and Address File (SSEL-NA) to link components of the LEHD with Compustat.

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[9] We thank Lynn M. LoPucki at UCLA for sharing this database.

[10] The sample period starts after 1979 to ensure that sample firms fall under the 1978 Bankruptcy Reform Act, which marked a substantial change to U.S. bankruptcy law. 1978 Bankruptcy Reform Act established the current system of federal bankruptcy courts and the regime of Chapter 11 reorganization, and became effective on October 1, 1979.

[11] See p. 15 of the following document for the list of states covered by LEHD as of August 2008: http://lehd.did.census.gov/led/library/tech_user_guides/overview_master_zero_obs_103008.pdf.

We restrict our sample to workers for whom we have information on age, education, and gender, which serve as controls in our wage regressions. To avoid complications associated with early retirement and legal ages for employment, we exclude workers who are older than 55 or younger than 22 in the year before a bankruptcy filing. Furthermore, we focus on "long-tenure" workers (i.e., workers with six or more years of tenure with the bankrupt firm one year before its Chapter 11 filing) who presumably have accumulated significant (specific) human capital at the time of bankruptcy filing (Jacobson, LaLonde, and Sullivan, 1993).

Because employee wage is our key variable, here we provide some details on the wage information in the LEHD. Based on Abowd et al. (2005), the LEHD wage data are on a quarterly basis, with historical time series extending back to the early 1990s for many states. The LEHD wage records are extracted from the state unemployment insurance (UI) records and correspond to the report of an individual's UI-covered earnings. An individual's UI wage record is retained in the database as long as the worker earns at least one dollar of UI-covered earnings during a given quarter in the LEHD universe. According to the Bureau of Labor Statistics, UI coverage is broad and comparable across states. In 1994, UI covered 96% of total jobs and covered workers received 92.5% of the wage component of national income. The UI wages include gross wages and salaries, bonuses, stock options, tips and other gratuities, and the value of meals and lodging, where supplied. In some of the states, employer contributions to certain deferred compensation plans, such as 401(K), are included in total wages.[12]

In addition to the LEHD datasets, we use the Longitudinal Business Database (LBD) to collect additional information on total wages and the number of employees at the firm level. The LBD tracks more than five million establishments every year, essentially covering the entire U.S. economy. The variables available in the database include the number of employees,

[12] See www.bls.gov/opub/hom/homch5_b.htm at the Bureau of Labor Statistics.

annual payroll, industry classifications, geographical location (at the county or zip code level), and parent firm identifiers. Given that the LEHD program provides employment data only for thirty participating states, the LBD is useful to obtain more comprehensive data on employment at bankruptcy firms.

2.2 Summary Statistics

Table 1 presents summary statistics on bankrupt firms. These statistics are based on data from their latest fiscal year before bankruptcy. Panel A shows that during the sample period from 1992 to 2008, 138 out of 412 (33%) bankrupt events from the Bankruptcy Research Database (BRD) with Compustat information have matched workers from the LEHD.[13] Perhaps not surprisingly, 70% (99 out of 138) of the firms are clustered during the technology bubble and the recession afterward (1998-2003) (Panel B). And 43% of the 138 cases are in the manufacturing sector (Panel C).

In Panel D of Table 1, we examine whether the sample of bankrupt firms matched with the LEHD is representative of the full sample of bankrupt firms from the BRD by comparing the characteristics of the two groups. The panel shows that the bankrupt firms matched with the LEHD are on average larger than the full sample of bankruptcy firms from the BRD in terms of sales, book and market assets, market equity, and the number of employees.[14] Both groups of firms are highly leveraged with about 65% mean book leverage one year before a bankruptcy filing, and have similar mean market-to-book ratios at around 1.1. The average return on assets of the matched sample is 5%, which is higher than that of the full bankruptcy sample (2%). In

[13] The LEHD program covers the period from 1990 to 2008. Since we require pre-bankruptcy information on wages, bankruptcy events in the final sample begin from 1992. The low match rate is also due to that LEHD covers thirty states and in earlier periods, fewer states.
[14] The Census Bureau does not permit disclosing median values.

addition, compared to the full sample of bankrupt firms in the BRD, the bankrupt firms matched to the LEHD have higher labor intensity and pay a lower wage per worker.

[Table 1 about here]

Table 1, Panel E shows the dynamics of firm characteristics beginning from five years to one year before a bankruptcy filing. Over the five year period before bankruptcy, leverage ratios increase from 40% to 65%, and return on assets (ROA) declines from 0.14 to 0.04. The market-to-book ratio also declines from 1.54 to 1.05. Similarly, other variables such as market value of equity, the number of employees, and the average wage per worker experience marginal declines over the period. These trends indicate that an increase in financial leverage and a significant deterioration in profitability and firm value before Chapter 11 filings.

Table 2 presents summary statistics on employees of the bankrupt firms at one year prior to bankruptcy filings using information from the LEHD during the 1992-2008 period. Following the literature (e.g., von Wachter, Song, and Manchester, 2009; Couch and Placzek, 2010; Davis and von Wachter, 2011) we construct a control sample of employees who are i) employed by non-bankrupt firms and ii) not displaced from an employer. Due to computational constraints, we only use randomly selected 1% workers from the LEHD universe who satisfy the criteria as a control group. We impose the same requirements for industry (i.e., excluding financial and utilities sectors), tenure, and age on the control group as for the workers in the sample of bankrupt firms.

The table shows that employees in the bankrupt firms have similar levels of education (14 years, indicating that average workers have some college education) with those in the control group. In addition, workers in the bankruptcy and control groups have similar age and work experiences (43 vs. 42 and 23 vs. 22). However, the average wage (in 2001 constant dollars) of the employees of bankrupt firms is about $5,000 less than that for the control group

of workers. Finally, the table shows that only 55% of employees stay with the bankrupt firms five years after bankruptcy, indicating that a significant fraction of workers leave the firm post-bankruptcy (Hotchkiss, 1995).

[Table 2 about here]

3. Empirical Results

3.1 Wage Trends before and after Bankruptcy

In this section, we analyze univariate changes in wages of workers employed by bankrupt firms. Table 3 presents the evolution of average wages for all employees in the bankrupt firms matched with LEHD at each point in time from five years before to five years after bankruptcy. The average wage declines over the years starting from t-3, with the sharpest decline at year t. In year t, the average wage declines by 21% relative to the benchmark level in year t-5. The decline in wages is persistent: Up until year t+5, the cumulative decrease in the average employee wage relative to t-5 reaches 32% of the pre-bankruptcy wages.

[Table 3 about here]

3.2 Difference-in-Difference Estimates of Wage Loss in Bankruptcy

One limitation of the univariate analysis in the previous section is that factors other than bankruptcy events, such as macroeconomic and industry conditions, or unobserved heterogeneity across workers may drive the changes in wages after bankruptcy. For example, employees of bankrupt firms may have low abilities and thus experience declines in wages. To deal with concerns of this sort, we perform multivariate regression analysis of wage loss using a difference-in-difference framework. Specifically, we estimate the following regression equation:

$$y_{it} = \alpha_i + \gamma_t + x_{it}\beta + \sum_{k=-m}^{m} D_{it}^{k}\delta_k + \varepsilon_{it}, \quad (1)$$

where i indicates workers and t indicates years, and y_{it} is worker i's log real wage in year t. α_i and γ_t denote worker and time fixed effects, respectively. x_{it} includes observable worker characteristics, and D_{it}^{k} is a dummy variable equal to one if year t is k years after (or before if k < 0) bankruptcy and zero otherwise ($-4 \leq k \leq 5$). ε_{it} is the error term.

In Table 4 Column (1), we include workers who were employed by bankrupt firms in the sample one year prior to a bankruptcy filing (but do not include a control group of workers). Column (1) thus shows results of a fixed-effect regression that includes worker and year fixed effects. The control variables x_{it} include the following employee characteristics: years of experience, years of education × years of experience, and years of experience × gender. We do not include education and gender individually because they are absorbed by the worker fixed effects, and age because it is collinear with work experience and education.

[Table 4 about here]

In Columns (2) and (3) of Table 4, we introduce a control group of workers (1% randomly sampled workers from the LEHD universe) and pool them with employees of bankrupt firms (i.e., treatment group). In addition to the controls in Column (2), Column (3) further includes two-digit SIC industry fixed effects to control for different wage levels across industries. We then perform a difference-in-difference regression using the comparison group to estimate the earnings changes that would have occurred in the absence of bankruptcy (i.e., counterfactual earnings), controlling for worker and year fixed effects and individual characteristics. The estimates of δ_k capture the change in employee wages of bankrupt

companies during each year relative to control firms, and thus are our main interest. Specifically, we estimate the following equation:

$$y_{it} = \alpha_i + \gamma_t + x_{it}\beta + \sum_{k=-m}^{m} Bankruptcy_i \times D_{it}^{k}\delta_k + \varepsilon_{it}, \quad (2)$$

where $Bankruptcy_i$ is an indicator variable equal to one if worker i was an employee of a bankrupt firm and zero if the worker is in the control group. The definitions of other variables are the same as in those in Equation (1).

Table 4 reports the estimates of δ_k. The regression results show that there is an increase in wages up till two years prior to bankruptcy. The regressions further show that employee wages start to decline significantly from year t-1 and the lower wages persist several years after bankruptcy (all the indicator variables for years t to t+5 are significantly negative at a conventional level in columns 2 and 3). This result suggests that after controlling for year and individual worker fixed effects and observable worker characteristics, there is a significant labor income loss (about 30% compared with the pre-bankruptcy income level) for employees of the bankrupt firms, relative to those of the non-bankrupt firms.[15] The magnitude of this income loss is consistent with that of the estimate obtained in the univariate analysis in Table 3.

Figure 1 visually presents the cumulative wage change based on the estimates in Table 4, Column 3. The figure shows that the wage of employees of bankrupt firms increases slightly till year t-3 and then starts to deteriorate in year t-1 (the year before bankruptcy filing). For

[15] We use the coefficient estimates on the indicator variables from t-1 to t+5 in Table 4 to obtain the magnitude of income loss. For example, the coefficient on the t-1 indicator variable in Column (3) is -0.082, which is the difference between log(wage in t-1) and log(benchmark wage). This means that the wage in t-1 divided by the benchmark wage is equal to exp(-0.082)=0.92, which implies an 8% decline of wage in t-1 relative to the benchmark wage. We perform the same calculation using the coefficients on the indicator variables from t to t+5, and then obtain an average annual wage loss of 28% relative to the benchmark wage. The average annual loss is 24% and 36% respectively if we use the estimates from Column (1) and Column (2).

each year from year t+1 to t+5, the employees lose about one third of the benchmark wage (the average wage across t-6 and t-5).

[Figure 1 about here]

3.3 Cross Sectional Variation in Wage Loss

Our main analysis shows a significant decline in wages for employees in bankrupt firms. In this section, we investigate potential reasons that those workers experience significant earnings losses after bankruptcy filings of their employers. Particularly, in Table 5 Column (1), we examine whether the magnitudes of wage losses are different between the employees who stay with the bankrupt firm and those who leave the firm. We employ an indicator variable which is equal to one if the worker leaves the bankrupt firm within five years post-bankruptcy and zero otherwise. We then interact the dummy variable with the event time indicators for t-4 to t+5 in our regression.

Column (1) shows that the coefficients on the event time indicators exhibit generally smaller magnitude compared to those in the main regression models in Table 5, indicating that the employees who stay with the bankrupt firms experience a smaller (yet significant) wage loss during the post-bankruptcy period than the average worker of the bankrupt firms. The coefficients on the interaction terms between the dummy variable and the time indicators are negative and significant from year t through t+4, suggesting that the employees who ultimately leave the bankrupt firms experience a significantly larger wage loss than those who remain in the firms. For example, four years after the bankruptcy filing, workers who leave the firm lose 47% of their annual wages, while those who stay with the firm lose only 22% of their annual wages. This result suggests that loss of firm-specific human capital (which is presumably lost once workers leave a firm) accounts for part of the wage losses.

[Table 5 about here]

In Table 5 Column (2), we define a dummy variable equals to one if the worker leaves the industry that he or she has been working in at the bankrupt firm, and zero otherwise. The result shows that both groups of workers experience significant wage losses. Perhaps not surprisingly, the workers who switch their industry after bankruptcy see a larger wage cut than those who stay within the previous industry, suggesting that a loss of industry-specific human capital drives part of the wage loss (Neal, 1995).

Next, we examine whether the magnitude of wage losses varies depending on the extent to which workers are covered by labor unions. We obtain industry-level data on union coverage from Hirsch and Macpherson (2003) who collect the information from the Current Population Survey Outgoing Rotation Group Earnings Files. Then, we define a dummy variable equals to one if the worker is employed in an industry having an above-median level of union coverage, and zero otherwise. The results in Table 5 Column (3) show that wage losses are larger for employees in industries with higher unionization rates. One plausible explanation for this result is that employees in highly unionized industries are paid wage premium above the market wage before bankruptcy due to union rent. Then, these workers might have experienced a larger wage loss post-bankruptcy by moving to a less unionized employer or by downward renegotiating of their wages during financial distress.

3.4 Wage Loss and Capital Structure

In this section, we use our regression estimates in Table 4, Column (3) to provide a back-of-the-envelope estimate of the present value of wage losses (relative to firm value). Panel E of Table 1 shows that the average real wage per worker for bankrupt firms in t-5 is $37,876. Based on the regression coefficients in Table 4 Column (3) and assuming a 5% real

discount rate, the present value of wage losses per worker from t to t+5 is equal to $51,021.[16] In addition, the number of employees at t-5 is 15,728 for an average bankrupt firm. Hence, the total present value of wage loss for an average firm is $802.46 million (= $51,021 × 15,728). Given that the average market value of assets for sample firms is about $2,754 million in t-1 ($1,652 million in t-5), the present value of wage losses for years t to t+5 as a ratio of firm value ranges from 29% (if using market assets in t-1) to 49% (if using market assets in t-5), suggesting a significant employee wage loss due to bankruptcy relative to firm value.

[Table 6 about here]

The estimates in Table 6 give us an idea of the magnitude of "ex post human costs of bankruptcy." An employee who works for a firm with a larger ex post wage loss due to bankruptcy would require a wage premium ex ante, or else the employee will work for a firm that has a lower ex post wage loss, all else equal. In order to examine the implication of the *ex post* wage loss estimates for a firm's *ex ante* capital structure choice, we need to translate these numbers into an *ex ante* wage cost for firms induced by their use of leverage.

To convert the ex post wage loss into the ex ante wage premium, we follow an approach similar to that in Almeida and Philippon (2007) and derive the present value of wage loss, using a simple valuation tree and the risk-adjusted default probability. We provide the details of the approach in Appendix B. The basic idea is that considering future bankruptcy costs (i.e., wage losses), an employee would demand the same risk-adjusted present value of expected wages from two companies with different bankruptcy probabilities (but everything else are the same). Our result is intuitive: the additional ex-ante wage premium is equal to the increase in the present value of the expected wage loss due to bankruptcy.

[16] See Table 6 for a detailed procedure to compute the present value of wage loss per worker.

Table 7 provides the estimation results of wage premiums by credit ratings, based on a simple two-period model and an infinite-horizon model. The estimates in the two-period model consider only one year of ex-post wage loss, while those in the infinite horizon model consider all future ex-post wage losses. These estimates can be thought of as the lower and the upper bounds of the wage premium due to potential bankruptcy, respectively.

An accurate estimation of the wage premium requires information on the expected tenure of employees in potential bankrupt firms. A recent report by the Bureau of Labor Statistics shows that the median number of years that workers had been with their current employer is 4.6 in January 2012.[17] Note, however, that the *expected* tenure of workers is likely longer than the *realized* tenure of current employees given their expected future employment in the current firm. Thus, we examine the robustness of our estimation by computing the wage premiums assuming periods of five and ten years as well. For each of the credit rating groups, we calculate the wage premium as a percentage of the market value of assets, and then compare the premiums with the estimates of tax benefit of debt provided by Almeida and Philippon (2007) and Molina (2005). Table 7 shows that the magnitude of the ex-ante wage premium is of similar magnitude to that of the marginal tax benefit of debt across credit ratings under the assumed expected tenure of five years or larger.

[Table 7 about here]

The estimates in Table 7 need to be interpreted with a few caveats in mind. First, our estimates of wage loss are based on the average ex-post wage loss across all bankrupt firms in our sample. The magnitude of wage losses due to bankruptcy could differ across different companies and across different ratings. For instance, it is possible that a wage loss is larger for

[17] See http://www.bls.gov/news.release/pdf/tenure.pdf.

low rating firms than for high rating firms, and thus the estimates of the ex-ante wage cost based on the full sample may under-estimate the cost for firms with low ratings. Second, we use the (risk-adjusted) probability of default in estimating the wage costs for the sample of the firms that actually filed for Chapter 11 (i.e., bankruptcy). It is possible that default probability is larger than the probability of bankruptcy filings and thus our estimates may be biased upward.

4. Discussions

The results in this paper should be interpreted with the following caveats in mind. First, high leverage could lead to financial distress, but not necessarily bankruptcy. For example, firms in financial distress could resolve distress through out-of-court private workout. In this paper, we estimate the human capital loss resulting from bankruptcy (i.e., Chapter 11) filings. Because firms that file for Chapter 11 could experience more severe financial distress than firms that choose a private workout, our estimates for worker wage losses may be biased upwardly.

Second, our study does not distinguish whether bankruptcy is caused by financial distress (e.g., the firm's financial positions deteriorate due to high debt burden even if its underlying operations remain strong) or by economic distress. Our sample firms have an average leverage ratio as high as 65% one year prior to bankruptcy (see Table 1), suggesting that the firms may be in financial distress. At the same time, the average ROA (whose nominator is EBITDA) is 5%, lower than the average ROA for Compustat firms (about 10%). These statistics indicate that bankrupt firms in our sample may experience both financial and operational distress.

Third, it is possible that firms that file for bankrupt ex post are those that have low ex-ante costs of financial distress. That is, these firms may have chosen highly levered capital structure exactly because they expected lower costs of financial distress. To the extent that firms "self-select" to bankruptcy in this manner, our estimates of wage losses may understate the costs of financial distress for the entire universe of firms.

5. Conclusion

This study quantifies the human costs of bankruptcy. We find that employee wages start to deteriorate prior to bankruptcy and the decline in wages persists at least for five years after bankruptcy. The magnitude of the decline in annual wages one year after a bankruptcy filing is about 30% of pre-bankruptcy wages. In addition, using the estimated human costs of bankruptcy, we provide an estimate of total wage losses relative to firm value. We then convert the ex-post wage loss into an ex-ante wage premium from the perspective of the firm. We find that for the average firm, the ex-ante wage premium is of similar magnitude to that of the tax benefits of debt. The analysis in this paper thus suggests that the cost of debt associated with employee wage losses in financial distress could potentially explain the conservative debt usage by U.S. corporations.

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Table 1
Summary Statistics on Bankruptcy Events and Firm Characteristics

This table provides summary statistics on the events of corporate bankruptcy fillings from 1992 to 2008 obtained from Lynn LoPucki. Panel A shows the procedure to select a sample of bankruptcy events used in this paper. We exclude firms in the financial and utilities sectors because leverage ratios in these firms are not directly comparable with those of industrial firms. BRB refers to LEHD-Business Register Bridge, which is used to link the LEHD data to other Census datasets. Panel B (Panel C) breaks down the number of events by period (industry sector). Census Bureau disclosure rules do not allow us to break down in further detail (e.g., by year or 1-digit SIC industry) because then the number of events becomes too small for some years, which may lead to a disclosure risk. Panel D shows summary statistics on characteristics of firms that file for bankruptcy. The statistics are based on values for the latest fiscal year before bankruptcy (usually year t-1, t-2, or t-3, where "year t" is the year of bankruptcy filings). Panel E presents the dynamics of bankrupt firms' mean characteristics from t-5 to t-1. "Sales" is total sales; "Cash flow" is defined as (net income + depreciation and amortization)/lagged assets; "Book value of assets" is total book value of assets in millions of dollars; "Market value of equity" is market capitalization in millions of dollars; "Book (Market) leverage" is defined as total debt/(total debt + book (market) value of equity); "ROA" is operating income before depreciation and amortizations / lagged assets; "M2B" is defined as (book value of debt + market value of equity)/(book value of debt + book value of equity); "N. emp" is the number of employees in a firm, measured in thousands; "Wage/assets" is total wage from the (Longitudinal Business Database) LBD/book assets; "Wage per worker" is total wage/number of employees in a firm from the LBD. All dollar amounts are CPI-adjusted based on year 2001 constant dollar.

Panel A: Sample Selection Procedure for Bankruptcy Events

Sample Selection Procedure	Num. Events
All Bankruptcy Cases from LoPucki Database from 1992 to 2008	586
Exclude financialand utilities sectors	503
Matched with Compustat and BRB	412
Matched with LEHD data	138

Panel B: Number of Bankruptcy Events by Period

Year	All events	LEHD-matched	Match rate
1992-1997	81	11	0.14
1998-2003	265	99	0.37
2004-2008	66	28	0.42
Total	412	138	0.33

Panel C: Number of Bankruptcy Events by Sector

Sector	LEHD-matched	Fraction
Manufacturing	59	0.43
Non-manufacturing	79	0.57
Total	138	1.00

Panel D: Characteristics of Bankrupt Firms

Sample	LEHD-matched bankrupt firms		All bankrupt firms	
Variable	**Mean**	**STD**	**Mean**	**STD**
Sales ($m)	2,607	9,186	1,598	6,017
Book value of assets ($m)	1,758	5,656	1,291	3,808
Market value of assets ($m)	2,345	10,741	1,609	7,104
Market value of equity ($m)	637	5,246	363	3,303
Book leverage	0.64	0.38	0.66	0.39
Market leverage	0.65	0.37	0.65	0.38
ROA	0.05	0.11	0.02	0.19
M2B	1.08	0.72	1.14	0.86
N. emp. (000)	13,762	28,226	8,310	19,700
Wage / Assets	0.39	0.81	0.30	0.93
Wage per worker ($)	35,346	19,216	42,436	33,811
No. firm-level observations	138	-	355	-

Panel E: Evolution of Mean Firm Characteristics before Bankruptcy

Year	t-5	t-4	t-3	t-2	t-1
Sales ($m)	1,921	2,085	2,315	2,532	3,022
Book value of assets ($m)	1,478	1,632	1,805	1,971	2,081
Market value of assets ($m)	1,652	1,920	2,106	2,390	2,754
Market value of equity ($m)	662	861	892	828	781
Book leverage	0.41	0.43	0.45	0.52	0.63
Market leverage	0.36	0.37	0.41	0.49	0.64
ROA	0.14	0.14	0.11	0.08	0.04
M2B	1.54	1.65	1.49	1.23	1.05
N. emp. (000)	15,728	15,351	16,160	15,772	14,344
Wage per worker ($)	37,876	41,546	36,595	36,564	36,033
No. of firm level observations	104	104	104	104	104

Table 2
Summary Statistics on Employees in Bankrupt Firms

This table provides summary statistics of the workers who are employed by a bankrupt firm one year prior to the bankruptcy filing. The wage data are from the LEHD-EHF (Employment History Files) and cover the period from 1992 to 2008. We require that the sample workers have at least 6 years of experience and are aged between 22 and 55 in the year before the bankruptcy filing (i.e., year t-1). We adjust wages for inflation using CPI (based on year 2001 constant dollar). The control group is a 1% random sample of workers from the entire LEHD-EHF data who are not displaced, and satisfies the same requirements for industry (i.e., excluding finance and utilities sectors), tenure, and age as the workers in the bankruptcy sample.

	(1)	(2)	(3)	(4)
Sample:	**Workers in bankrupt firms**		**Workers in control group**	
	Mean	STD	Mean	STD
Years of education	13.7	2.3	13.8	2.4
Age	42.8	7.8	41.7	8.3
Years of experience	23.1	7.8	21.9	8.2
Wage (t-1) in 2001 dollar	39,956	34,609	44,777	35,003
% of females	44%	50%	44%	50%
% of workers who stay with bankrupt firm till t+5	55%	50%	-	-
Num. of employees	96,538		136,657	
Num. of firms	138		3,010	

Table 3
Mean Wage Trend before and after Bankruptcy

This table shows the dynamics of mean wages for all the workers employed by firms that file bankruptcy in year t. For each of the years surrounding bankruptcy (i.e., from t-5 to t+5), we first calculate the average wage among all the employees present in the company in the particular year (Column 1), and then estimate the percentage wage change relative to the average wage for the base year t-5 (Column 2). For each year, the percentage wage change relative to one year earlier is presented in Column (3).

Event year	(1) Average wage in 2001 constant dollar	(2) Cumulative wage change relative to t-5	(3) Wage change relative to the previous year
t-5	42,419	-	-
t-4	48,036	13.2%	13.2%
t-3	44,701	5.4%	-6.9%
t-2	43,686	3.0%	-2.3%
t-1	42,594	0.4%	-2.5%
t	33,577	-20.8%	-21.2%
t+1	31,575	-25.6%	-6.0%
t+2	31,030	-26.9%	-1.7%
t+3	31,643	-25.4%	2.0%
t+4	30,335	-28.5%	-4.1%
t+5	28,765	-32.2%	-5.2%

Table 4
Regression Analysis of Wage Losses around Bankruptcy

This table shows results for the regression analysis of wage losses for workers employed by bankrupt firms one year prior to the bankruptcy filing. The dependent variable is log(wage in real dollars), where real wage is the wage in 2001 constant dollar. (1) - (3) are based on difference-in-difference regressions with worker and year fixed effects, while (4) further includes (2-digit SIC) industry fixed effects. All of the regressions control for the following worker characteristics: years of experience, years of education × years of experience, and gender × years of experience. This table reports the coefficient estimates for the event year indicator variables: d[t+j], where j = -4 to +5. The regressions use the observations from t-6 to t+5 and the benchmark wage is constructed as the average wage between t-6 and t-5. This is to reduce noise from using one year as benchmark. Detailed definitions of all the variables are reported in Appendix A. Heteroskedasticity robust t-statistics adjusted for within firm clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
Sample:	Bankruptcy sample only	Bankruptcy + control samples	Bankruptcy + control samples
Dep. Var.:	Log(wage)	Log(wage)	Log(wage)
d[t-4]	.058	.052	.047
	(1.97)**	(2.05)**	(1.90)*
d[t-3]	.092	.078	.067
	(2.98)***	(3.18)***	(3.01)***
d[t-2]	.094	.080	.061
	(1.98)**	(2.18)**	(1.80)*
d[t-1]	-.030	-.058	-.082
	(-.55)	(-1.60)	(-2.34)**
d[t]	-.146	-.180	-.175
	(-1.44)	(-2.20)**	(-2.38)**
d[t+1]	-.308	-.362	-.327
	(-2.29)**	(-3.45)***	(-3.60)***
d[t+2]	-.294	-.381	-.295
	(-2.06)**	(-3.69)***	(-3.28)***
d[t+3]	-.307	-.422	-.318
	(-1.94)*	(-3.85)***	(-3.36)***
d[t+4]	-.278	-.442	-.335
	(-1.44)	(-3.39)***	(-2.85)***
d[t+5]	-.277	-.441	-.329
	(-1.22)	(-2.96)***	(-2.40)**
Worker-level controls	Y	Y	Y
Year fixed effects	Y	Y	Y
Employee fixed effects	Y	Y	Y
Industry (SIC2) fixed effects	N	N	Y
No. of worker-year obs.	806,914	2,097,689	2,097,689
R-squared	65.49%	66.35%	69.05%

Table 5
Wage Loss by Displacement Status and Pre-bankruptcy Union Coverage

This table presents the estimates of wage losses in bankruptcy, conditional on whether an employee stays with or leave the bankrupt firm (column 1) or industry (column 2) and whether the bankrupt firm is in a highly unionized industry (column 3). "Dummy" is equal to one if an employee leaves his/her current employer that is in distress (column 1), two-digit SIC industry (column 2), or the bankrupt employer is in an above-median union coverage industry (column 3). Median union coverage is based on the t-1 union coverage of the industries in which the workers' employers are. All dollar amounts are CPI-adjusted based on year 2001 constant dollar. Heteroskedasticity robust t-statistics adjusted for within firm clustering are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

	(1)	(2)	(3)
[Dummy = 1]:	Switch (Firm)	Switch (Industry)	High union coverage
Dep. Var.:	log(wage)	log(wage)	log(wage)
d[t-4]	.037	.044	.070
	(1.36)	(1.77)*	(1.41)
d[t-3]	.056	.063	.109
	(2.79)***	(3.15)***	(2.26)**
d[t-2]	.047	.057	.108
	(1.59)	(1.90)*	(1.64)
d[t-1]	-.079	-.067	.009
	(-3.25)***	(-2.61)***	(.10)
d[t]	-.128	-.138	-.138
	(-2.12)**	(-2.13)**	(-1.14)
d[t+1]	-.264	-.266	-.233
	(-3.57)***	(-3.49)***	(-1.46)
d[t+2]	-.184	-.209	-.233
	(-3.36)***	(-3.02)***	(-1.47)
d[t+3]	-.232	-.239	-.227
	(-4.34)***	(-3.57)***	(-1.29)
d[t+4]	-.249	-.267	-.216
	(-3.38)***	(-2.88)***	(-1.16)
d[t+5]	-.355	-.315	-.169
	(-2.32)**	(-2.46)**	(-.82)
d[t-4] x Dummy	.020	.004	-.021
	(.92)	(.18)	(-.42)
d[t-3] x Dummy	.028	.013	-.040
	(1.21)	(.65)	(-.99)
d[t-2] x Dummy	.047	.029	-.030
	(1.72)*	(1.24)	(-.58)
d[t-1] x Dummy	-.002	-.051	-.097
	(-.05)	(-1.15)	(-1.04)
d[t] x Dummy	-.215	-.263	-.044
	(-4.31)***	(-4.65)***	(-.50)

d[t+1] x Dummy	-.299	-.426	-.216
	(-4.32)***	(-6.28)***	(-1.75)*
d[t+2] x Dummy	-.420	-.547	-.248
	(-5.15)***	(-8.09)***	(-1.92)*
d[t+3] x Dummy	-.395	-.552	-.350
	(-3.81)***	(-7.10)***	(-2.45)**
d[t+4] x Dummy	-.395	-.533	-.423
	(-4.73)***	(-8.55)***	(-3.89)***
d[t+5] x Dummy	-.212	-.402	-.569
	(-1.33)	(-4.06)***	(-3.91)***
Worker-level controls	Y	Y	Y
Year fixed effects	Y	Y	Y
Individual fixed effects	Y	Y	Y
Observations (worker)	2,097,689	2,097,689	2,097,689
R-squared	66.58%	66.71%	66.51%

Table 6
Back-of-the-Envelope Estimate of Present Value of Wage Losses in Bankruptcy

This table presents a back-of-the-envelope estimate of the present value of wage losses for workers employed by bankrupt firms (relative to market value of the assets of the firm) based on the regression coefficients in Table 4, column 3. Present values are computed using a real discount rate of 5%. The values in items A, C, E1, and E2 come from Table 1, Panel E. The value in item B is estimated from the regression coefficients in Table 4, Column 3. Specifically, the regression coefficients on the event year indicators in Table 4 represent the change in log(wage) for the event year relative to the benchmark year, i.e., log(wage1)-log(wage0), where wage1 is the wage in the event year and wage0 is the wage in the benchmark year. Taking exponential of these coefficients and then deducting 1, we obtain the percent wage change (wage1-wage0)/wage0. Multiplying these percent wage changes by wage0 (which is item A, $37,876) gives the dollar amount of wage changes (wage1-wage0) for each year. Summing up the present values of these dollar wage changes from t to t+5 gives the value for item B (i.e., present value as of year t). All dollar amounts are CPI-adjusted based on year 2001 constant dollar.

Item	Variable	Value
A	Average real wage per worker for bankrupt firms in t-5	$37,876
B	Present value of wage losses per worker from t to t+5, based on regression coefficients in Table 4, Column 3	$51,021
C	Average number of employees per firm in t-5	15,728
D = B x C	PV of total wage loss for average firm	$802.46 m
E1	Average market value of assets in t-5	$1,652 m
E2	Average market value of assets in t-1	$2,754 m
F1 = D / E1	PV of total wage loss / market value of assets (t-5)	48.58%
F2 = D / E2	PV of total wage loss / market value of assets (t-1)	29.14%

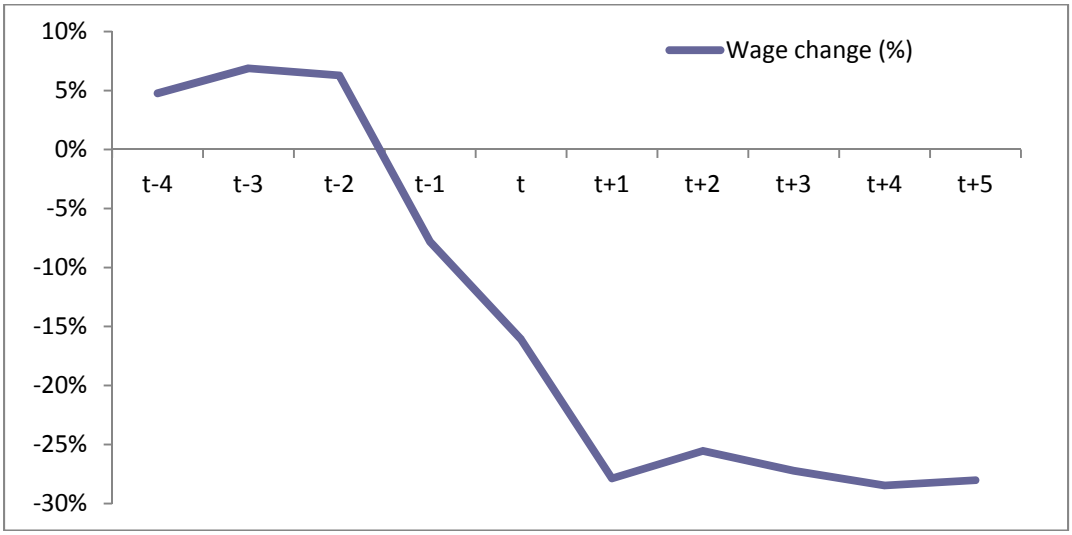
Table 7
An Estimation of Ex-ante Wage Premium

Using the ex-post wage loss numbers in Table 5, this table estimates the ex-ante expected wage loss (i.e., ex-ante wage premium). The one-year risk-adjusted default probability $q_{5,1}$ ($q_{10,1}$) is equal to = $1-(1- q_5)^{1/5}$ $(1-(1- q_{10})^{1/10})$, where q_5 (q_{10}) is the five-year (ten-year) risk-adjusted default probability provided in Almeida and Philippon (2007) (AP). We use the 5-year probability for 2-year and 5-year tenures (Columns 6 & 7) and the 10-year one for 10-year and infinite-year tenures (Columns 9 & 10). Denote the PV of total wage loss for average firm (802.46 million from Table 1 Panel E) as wl, and the average market value of sample firms ($2,754 million in t-1, from Table 1 Panel E) as A. Assume the risk free rate is 5% over our sample period. Then Column 6 = Column 5/(1+risk free rate)×wl/A, and Column 10 = Column 8/(Column 8 + risk free rate)×wl/A. Appendix B provides more detailed models and calculations. Tax benefits and wage premiums in the table are the present values of tax benefits and wage premiums, expressed as a percentage of pre-distress firm value.

Credit ratings	q_5 = Five-year risk adjusted default probability from Table III in AP	q_{10} = Ten-year risk adjusted default probability from Table III in AP	Tax benefits of debt (from Table VI in AP	$q_{5,1}$ = One year risk adjusted default probability based on q_5	Expected wage loss (two period model)	Expected wage loss (5 year tenure)	$q_{10,1}$ = One year risk adjusted default probability based on q_{10}	Expected wage loss (10 year tenure)	Expected wage loss (infinite period model)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
AAA	0.54%	1.65%	0.47%	0.11%	0.03%	0.15%	0.17%	0.42%	1.82%
AA	1.65%	6.75%	2.51%	0.33%	0.09%	0.45%	0.70%	1.72%	6.35%
A	7.07%	12.72%	4.40%	1.46%	0.41%	1.92%	1.35%	3.25%	10.22%
BBB	11.39%	20.88%	5.18%	2.39%	0.68%	3.09%	2.31%	5.35%	14.01%
BB	21.07%	39.16%	7.22%	4.62%	1.31%	5.72%	4.85%	10.09%	19.22%
B	34.90%	62.48%	8.95%	8.23%	2.34%	9.49%	9.34%	16.25%	22.98%
BBB minus AAA	10.85%	19.23%	4.71%	2.28%	0.65%	2.94%	2.15%	4.93%	12.19%

Figure 1
Changes in Wages for Workers Employed by Bankrupt Firms

This figure presents the real wage changes (in percent), relative to individual-level average wages for five and six years before bankruptcy, based on the regression results in Table 4, Column 3. In the figure, year t is the year of bankruptcy filing.



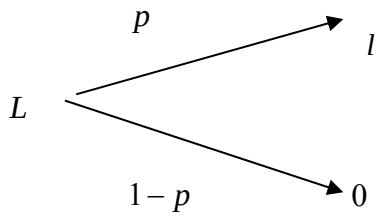
Appendix A: Definition of Variables

Variable Names	Variable Definitions
Book value of assets	Total book value of assets in $millions
Market value of assets	Market value of equity + book value of debt
Sales	Total sales of the company in $millions
Market value of equity	Market value of equity in $millions
Market to book	(Book value of debt + market value of equity)/(book value of debt + book value of equity)
Cash flow	(net income + depreciation and amortization)/lagged assets
Book (Market) leverage	Total debt/(total debt + book (market) value of equity), where total debt = long term debt + debt in current liabilities
ROA	operating income before depreciation and amortizations / lagged book assets
N. emp	Number of employees in a firm, measured in thousands
Wage/assets	Total wage in a firm / book assets
Wage per worker	Total wage/number of employees in a firm

Appendix B: Estimate wage premium due to human costs of bankruptcy

Because employees experience wage reductions or lose wages when a firm goes into bankruptcy, these employees will demand higher wages ex ante to compensate for such a potential loss. To estimate such wage premiums resulting from bankruptcy, we denote L as the NPV of an employee's expected wage loss, and W as the NPV of the wage that a firm pays when it is not in bankruptcy. $W - L$ is thus the NPV of the expected wage that a firm actually offers to its employees. We first derive the wage premium under a two period model, and then we extend the model to the multi-period case.

B.1 A two period model



where l is employee's wage loss when a firm defaults; p is the historical probability of default. Therefore,

$$L = \frac{pl}{(1 + r_D)}$$

where r_D is the appropriate discount rate. Employees are risk averse and bankruptcies are more likely to happen in bad times. Hence, $r_D < r_f$, the risk free rate. Because we don't know what is the appropriate discount rate r_D, to estimate L, we adopt a risk neutral approach proposed in Almeida and Philippon (2007). Specifically,

$$L = \frac{ql}{(1 + r_f)}$$

where q is the risk-adjusted probability of bankruptcy, and r_f is risk free rate.

Suppose a firm with a default probability q_1 is offering a competitive market wage to its employees, and the NPV of the wage when the firm is not in default is equal to W_1. If the firm's risk-adjusted bankruptcy probability increases from q_1 to q_2, to attract employees in the competitive labor market, the firm has to offer the same level of expected wage NPV to employees. This implies that

$$W_2 - L_2 = W_1 - L_1$$

$$\Rightarrow$$

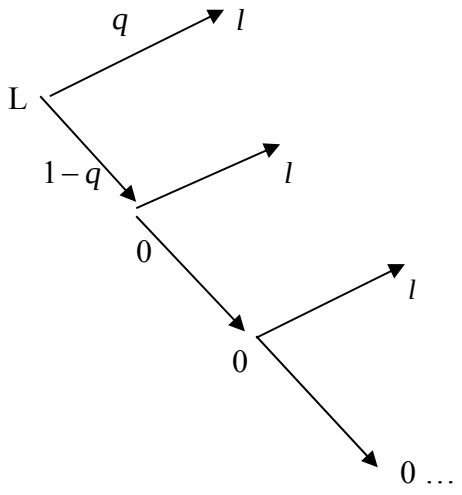
$$\text{Wage premium}=W_2 - W_1 = \frac{q_2 l}{(1+r_f)} - \frac{q_1 l}{(1+r_f)} = \frac{(q_2 - q_1)}{(1+r_f)} l$$

If we use a risk-free firm (i.e., q_1=0) as the benchmark, then the wage premium of a firm with default risk q_2 is equal to

$$\text{Wage premium over a risk free firm}=\frac{q_2}{1+r_f} l$$

This result is intuitive: wage premium is equal to the increase in the expected wage loss resulting from an increased default probability.

B.2 An infinite horizon model



Valuation in this infinite horizon model can be treated as a sequence of two period models.

$$L = \frac{ql + (1-q)L}{(1+r_f)} = \frac{ql}{q+r_f}$$

Considering a firm whose default probability increases from q_1 to q_2, to offer the employees the same expected wage, we need that

$W_1 - L_1 = W_2 - L_2 \Leftrightarrow$

$$W_2 - W_1 = L_2 - L_1 = \frac{q_2 l}{q_2 + r_f} - \frac{q_1 l}{q_1 + r_f} = \left(\frac{q_2}{q_2 + r_f} - \frac{q_1}{q_1 + r_f} \right) l$$

For example, if a firm's credit rating changes from AAA to BBB, to compensate workers for the increase in the expected wage loss, wage premium is equal to

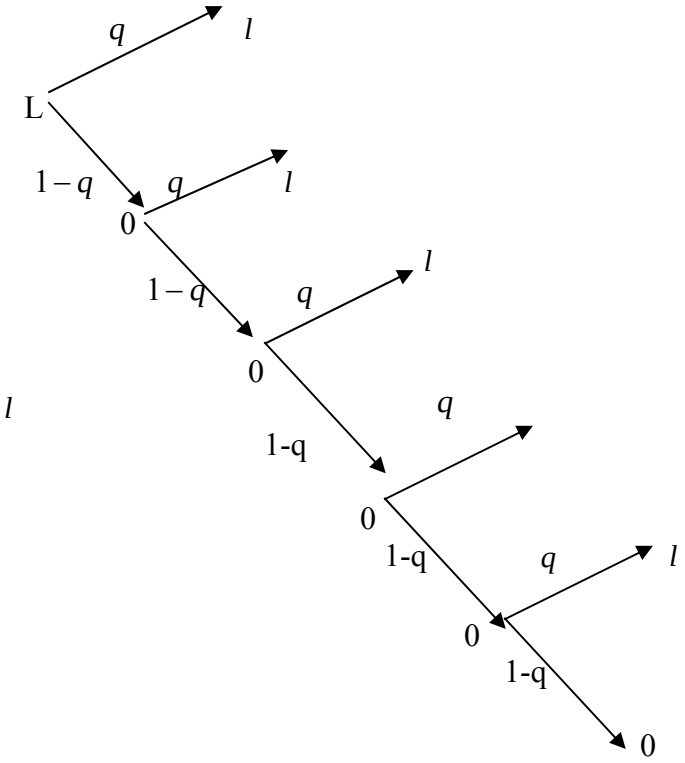
$$W_{BBB} - W_{AAA} = (\frac{q_{BBB}}{q_{BBB} + r_f} - \frac{q_{AAA}}{q_{AAA} + r_f})l$$

If we use a risk-free firm, $q = 0,$ as the benchmark, the wage premium of a firm with a default probability q is equal to

Wage premium over a risk free firm= $\frac{q}{q + r_f} l$

3. Finite period model

Here we assume that the employees stay with the company for an average of five years until the firm goes bankrupt. The model can be extended to any finite years.



Unconditional risk-adjusted default probability in year n=$(1-q)^{n-1}q$

Then the NPV of the wage loss in year n=$\frac{1}{(1+r_f)^n}(1-q)^{n-1}ql$

The total NPV of wage loss for employees who work for the firm for N years is equal to

$\sum_{n=1}^{N}\frac{1}{(1+r_f)^n}(1-q)^{n-1}ql$